

FCC RF Exposure Evaluation

Report Number:

F251358E3

Equipment under Test (EUT):

Mobile communication device

CT-DECT MULTI M7 G2

Applicant:

CEOTRONICS AG

Manufacturer:

CEOTRONICS AG



Deutsche
Akkreditierungsstelle
D-PL-17186-01-00

References

- [1] **CFR 47 Rule part 1** Practice and Procedure
 - [2] **CFR 47 Rule part 2** Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
 - [3] **KDB 447498 D04 Interim General RF Exposure Guidance v01**
 - [4] **ANSI C63.10: 2020 + Cor. 1-2023 + C63.10a-2024 + Errata to C63.10a-2024*** American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- *Remark: This standard is not in accreditation scope of the laboratory yet.

Assessed and
written by:



Paul NEUFELD
05.03.2026

Signature

Reviewed and
approved by:



Bernward ROHDE
05.03.2026

Signature

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1 Identification

1.1 Applicant

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Applicant represented during the test by the following person:	--

1.2 Manufacturer

Name:	CEOTRONICS AG
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Country:	Germany
Name for contact purposes:	Mr. Thorsten NEUHAUS
Phone:	+49 6074 8751 631
eMail address:	thorsten.neuhaus@ceotronics.com
Manufacturer represented during the test by the following person:	--

1.3 Test Laboratory

The tests were carried out by: **PHOENIX TESTLAB GmbH**
Königswinkel 10
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accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) according to DIN EN ISO/IEC 17025:2018. The accreditation is only valid for the scope of accreditation listed in the annex of the certificate D-PL-17186-01-00. FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

1.4 EUT (Equipment under Test)

Test object: *	Mobile communication device
Model name: *	CT-DECT MULTI M7 G2
Model number: *	No info provided
Order number: *	2400106-R1
Contains FCC ID's: *	L52CT-BT747 & L52CT-M7CEO1

* Declared by the applicant

	EUT number
	1
Serial number: *	CTX11111111
PCB identifier: *	4DTT08-1920-011-01-03, 4BT08-1920-011-04-02
Hardware version: *	Rev 3 and Rev 2
Software version: *	Multi-G2_0_12_3_xx

* Declared by the applicant

1.5 Technical Data of Equipment

General EUT data			
Power supply EUT: *	DC by Li-Polymer battery		
Supply voltage EUT: *	$U_{nom} = 3.7 \text{ V}_{DC}$	$U_{min} = 3.0 \text{ V}_{DC}$	$U_{max} = 4.2 \text{ V}_{DC}$
Temperature range: *	-32°C to +69°C		
Lowest / highest internal clock frequency: *	32.768 MHz / 2480 MHz		

* Declared by the applicant

Ports / Connectors of the Host				
Identification	Connector		Length during test	Shielding (Yes / No)
	EUT	Ancillary		
Headset	ODU HD Serie	Headphones HDSG-SSM-CLR	~1m	Yes

* Declared by the applicant

1.5.1 Operating Channels

Bluetooth Low Energy channels			
Channel 0	2402 MHz	Channel 1	2404 MHz
...	...	...	...
Channel 19	2440 MHz	Channel 20	2442 MHz
...	...	...	...
Channel 38	2478 MHz	Channel 39	2480 MHz

Bluetooth classic + EDR channels			
Channel 0	2402 MHz	Channel 1	2403 MHz
...	...	...	...
Channel 38	2440 MHz	Channel 39	2441 MHz
...	...	...	...
Channel 77	2479 MHz	Channel 78	2480 MHz

1.5.2 Radio capabilities

Bluetooth radio mode	
Fulfills radio specification: *	Bluetooth Low Energy 5.2 Bluetooth classic + EDR 5.2
Radio module: *	IDC747
Antenna type: *	chip antenna
Antenna name: *	No information provided
Antenna gain: *	0 dBi
Antenna connector: *	none
Supply voltage radio module: *	$U_{nom} = 3.7 V_{DC}$ $U_{min} = 3.3 V_{DC}$ $U_{max} = 4.7 V_{DC}$
Type of modulation: *	Bluetooth LE 1 Mbps 2 Mbps
	Bluetooth classic + EDR 1 Mbps 2 Mbps 3 Mbps
Operating frequency range: *	2402 MHz – 2480 MHz
Number of channels: *	Bluetooth LE 40
	Bluetooth classic+EDR 79

* Declared by the applicant

1.6 Additional Information

None

2 Evaluation Methods

2.1 RF exposure test exemptions for single sources

2.1.1 General Exemption CFR 47 §1.1307(b)(3)(i)(A)

The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in [paragraph \(b\)\(3\)\(ii\)\(A\)](#) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

2.1.2 SAR Based Exemption CFR 47 §1.1307(b)(3)(i)(B)

The available maximum time-averaged power of effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz inclusive.

For the following separation distances [d] and frequency ranges P_{th} is given by the following formulas

	0.5 cm $\leq d \leq 20$ cm	20 cm $< d \leq 40$ cm
0.3 GHz $\leq f < 1.5$ GHz	$P_{th}(mW) = ERP_{20cm} \left(\frac{d}{20} \right)^x$ $ERP_{20cm}(mW) = 2040f$ $x = -\log_{10} \left(\frac{60}{ERP_{20cm}\sqrt{f}} \right)$	$P_{th}(mW) = ERP_{20cm}$ $ERP_{20cm}(mW) = 2040f$
1.5 GHz $\leq f \leq 6$ GHz	$P_{th}(mW) = ERP_{20cm} \left(\frac{d}{20} \right)^x$ $ERP_{20cm}(mW) = 3060$ $x = -\log_{10} \left(\frac{60}{ERP_{20cm}\sqrt{f}} \right)$	$P_{th}(mW) = ERP_{20cm}$ $ERP_{20cm}(mW) = 3060$

Relaxation for extremities according to 2.1.1 [3]

Finally, when 10-g extremity SAR applies, SAR test exemption may be considered by applying a factor of 2.5 to the SAR-based exemption thresholds.

2.1.3 MPE Based Exemption CFR 47 §1.1307(b)(3)(i)(C)

By using Table 1 and the minimum separation distance (d in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, d must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

RF Source frequency [MHz]	Threshold ERP [W]
0.3 - 1.34	$1920 d^2$
1.34 – 30	$3450 d^2/f^2$
30 – 300	$3.83 d^2$
300 – 1500	$0.0128 d^2/f$
1500 - 100000	$19.2 d^2$

d : Minimal separation distance from antenna to the user

2.1.4 Stand alone MPE evaluation limits

The human exposure to RF emissions from such devices could be evaluated based on the MPE limits adopted by the FCC for electric and magnetic field strength and / or power density. The limits for General Population / Uncontrolled Exposure are given in the following table from CFR 47 §1.1310(e)1:

Frequency range [MHz]	Electric field strength (E) [V/m]	Magnetic field strength (H) [A/m]	Power density (S) [mW/cm ²]	Averaging time [min]
(i)Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	*(100)	≤6
3.0 – 30	1842/f	4.89/f	*(900/f ²)	<6
30 – 300	61.4	0.163	1.0	<6
300 – 1,500			f/300	<6
1,500 – 100,000			5	<6
(ii)Limits for General Population / Uncontrolled Exposure				
0.3 – 1.34	614	1.63	*(100)	< 30
1.34 – 30	824/f	2.19/f	*(180/f ²)	< 30
30 – 300	27.5	0.073	0.2	< 30
300 – 1500			f/1500	< 30
1500 – 100,000			1.0	< 30

Note: f = frequency in MHz; * Plane – wave equivalent power density

The power density is calculated as follows:

$$S = \frac{P \cdot G \cdot D}{4 \cdot \pi \cdot d^2}$$

Where:

P: conducted power

G: Antenna gain (linear)

D: Duty Cycle

d: Minimal separation distance from antenna to the user

2.2 RF exposure test exemptions for simultaneous transmission sources

2.2.1 1 mW Test Exemption for simultaneous transmission sources

As discussed in CFR 47 §1.1307(b)(3)(ii)(A) [1] the 1 mW exemption intended for single transmitters may be also applied to simultaneous transmission conditions, within the same host device, according one of the following criteria:

- a. When the maximum available power each individual transmitting antenna with the same time averaging period is ≤ 1 mW, and the nearest parts of the antenna structures of the simultaneously operating transmitters are separated by at least 2 cm
- b. When the aggregate maximum available power of all transmitting antennas is ≤ 1 mW in the same time-averaging period

This exemption may not be combined with any other exemption.

2.2.2 Simultaneous transmission SAR based and MPE based test exemptions

Although this is not a module integration in the sense of product approval, the procedure for simultaneous transmission specified in KDB 447498 D04 Interim General RF Exposure Guidance v01 [3] in chapter 2.2 was taken into account:

According to the RF exposure KDB 447498 D04 General RF Exposure Guidance v01 [3] in chapter 2.2.2: This case is described in detail in CFR 47 §1.1307(b)(3)(ii)(B) and covers the situations where both SAR-based and MPE-based exemption may be considered for test exemption in fixed, mobile, or portable device exposure conditions. For these cases, a device with multiple RF sources transmitting simultaneously will be considered an RF exempt device if the condition of the following formula is satisfied.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

For these test exemptions to apply, the maximum output power, duty factor, and other applicable parameters used in the standalone ERP determination tests, must be the same, or corresponding to a more conservative choice, than those required for simultaneous transmission.

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is ≤ 1.0 , according to calculated/estimated, numerically modelled, or measured field strengths or power density. The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to the MPE limit at the test frequency.

2.2.3 Test exemption based on the SAR to Peak Location Separation Ratio

When the ERP-based condition in the previous section does not apply, a test exemption may be still applicable based on the SAR to peak location separation ratio (SPLSR) procedure.

In this case, the simultaneously transmitting antennas in each operating mode and exposure condition combination must be considered one pair at a time to determine the SPLSR that qualifies for the additional test exemption.

This ratio is defined as:

$$SPLSR = (SAR_1 + SAR_2)^{\frac{1.5}{R_i}}$$

Where: SAR_1 and SAR_2 = highest reported SAR or estimated SAR values for the two sources in the pair i , and R_i is their distance in mm.

When $SPLSR \leq 0.04$ (rounded to two decimal digits), for all antenna pairs in the configuration, then the device qualifies for 1 g SAR test exemption.

When 10 g SAR applies (e.g. for extremities) the corresponding test exemption condition is $SPLSR \leq 0.10$.

If any antenna pair does not qualify for simultaneous transmission SAR test exemption, then the device must be tested for SAR compliance, according to the enlarged zoom scan and volume scan post-processing procedures in KDB Pub. 865664 D01.

3 Results of evaluation

3.1 Used evaluation methods

RF Exposure test exemptions for single sources			
Used	Method	See sub-clause	Comment
☐	General Exemption acc. CFR 47 §1.1307(b)(3)(i)(A)	2.1.1	-
☒	SAR Based Exemption acc. CFR 47 §1.1307(b)(3)(i)(B)	2.1.2	-
☐	MPE Based Exemption acc. CFR 47 §1.1307(b)(3)(i)(C)	0	-
☐	MPE Calculation	2.1.4	-

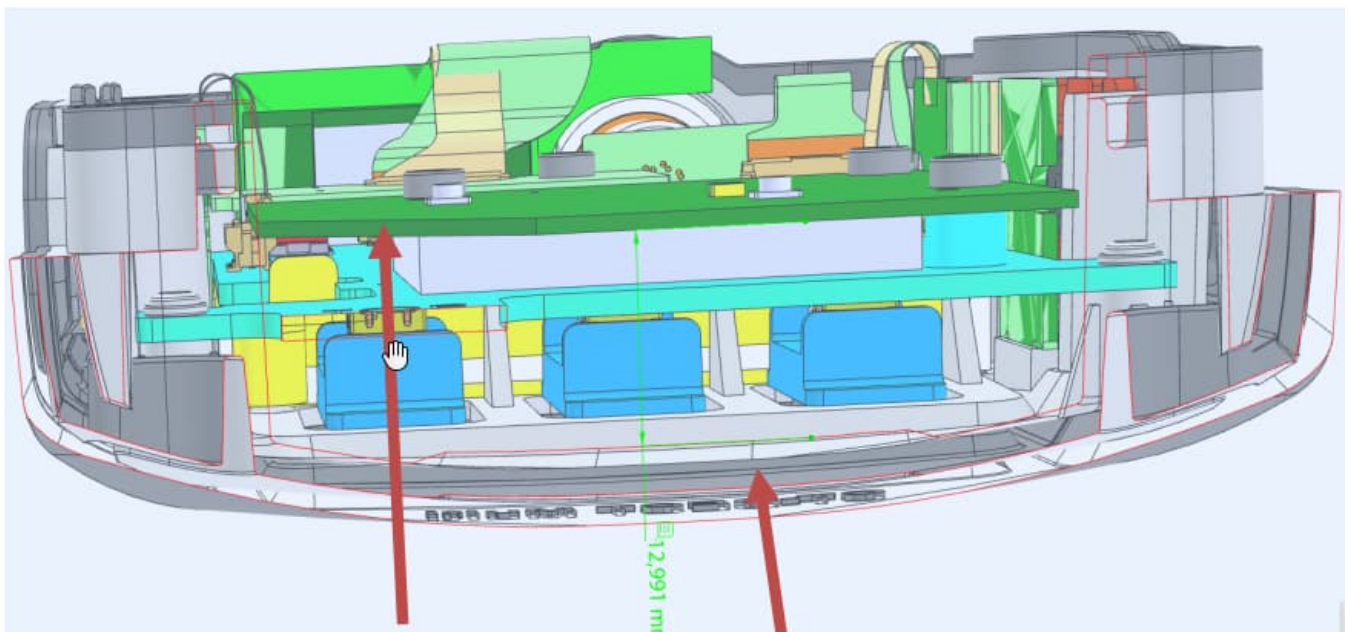
RF Exposure test exemptions for simultaneous transmission sources			
Used	Method	See sub-clause	Comment
☐	Not applicable	---	-
☐	1 mW test Exemption acc. 2.2.1 [3]	2.2.1	-
☒	SAR Based Exemption acc. 2.2.2 [3]	2.2.2	
☐	MPE Based Exemption acc. 2.2.2 [3]	2.2.2	
☐	SAR to Peak location separation ratio acc. 2.2.3 [3]	2.2.3	

3.2 Evaluation Distance

According to the CFR47 §2.1091 the device as declared by the applicant is a mobile device which is used at least with the following separation distances between the device and the users.

Antenna	Min separation distance as declared by the applicant
DECT antenna	15 mm
Bluetooth antenna	16 mm

DECT distance justification:



DECT module

EUT housing

As declared by the applicant, the DECT module has a distance of 13 mm to the inside of the housing + 2 mm thickness of the housing, which results in a minimum separation distance to the user of 15 mm.

Bluetooth distance justification:

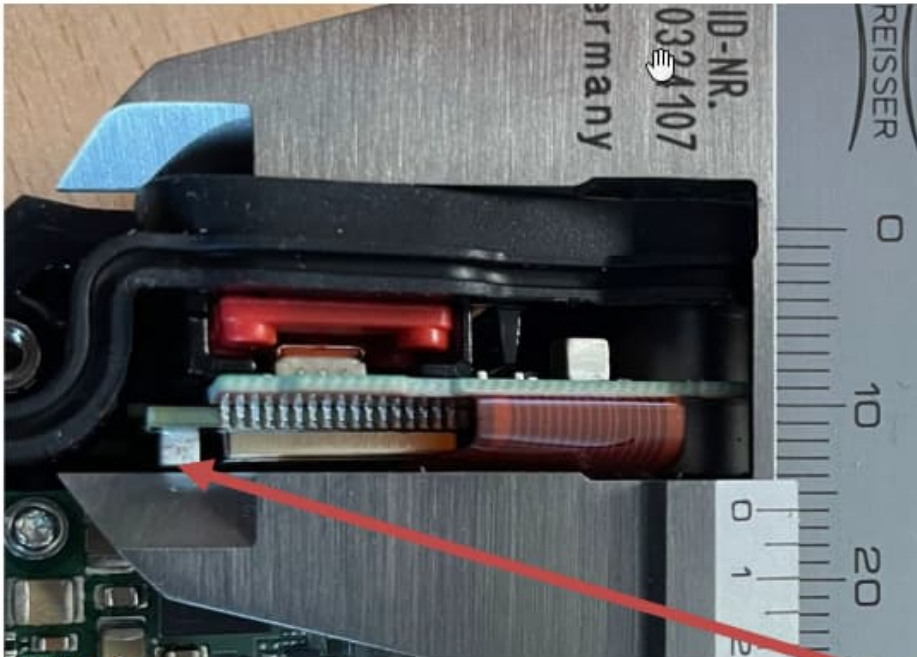


Abbildung 5

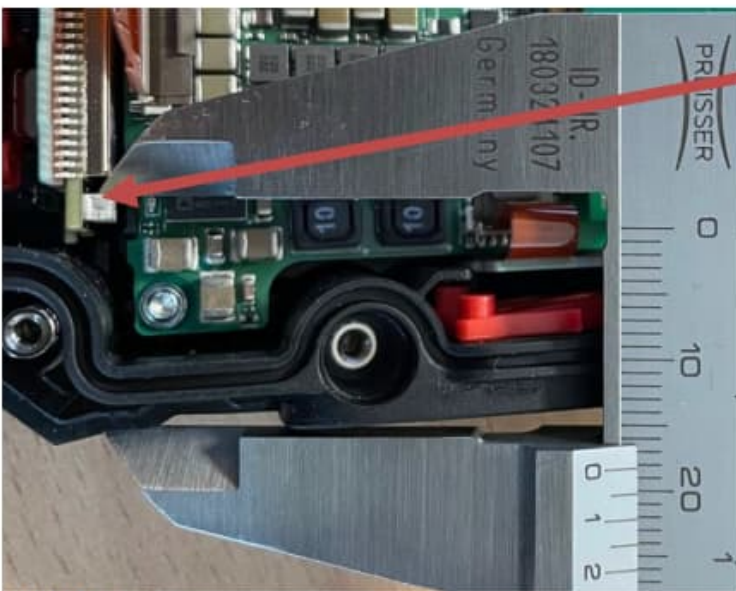


Abbildung 6

Bluetooth-Modul
mit Antenne

The photographs above were provided by the applicant and show, that the distance of the Bluetooth Antenna to the outside of the housing is either 16 mm or 18 mm. The following calculations were done with 16 mm distance, because that distance represents the worst case scenario.

The EUT only contains one Bluetooth module, which supports both Bluetooth classic+EDR and Bluetooth Low Energy modes. As declared by the applicant, Bluetooth classic+EDR and Bluetooth Low Energy cannot transmit simultaneously.

3.3 Justification for average power in DECT communications

The following justification is submitted by the applicant to explain the maximum TX on time for the used DECT system.

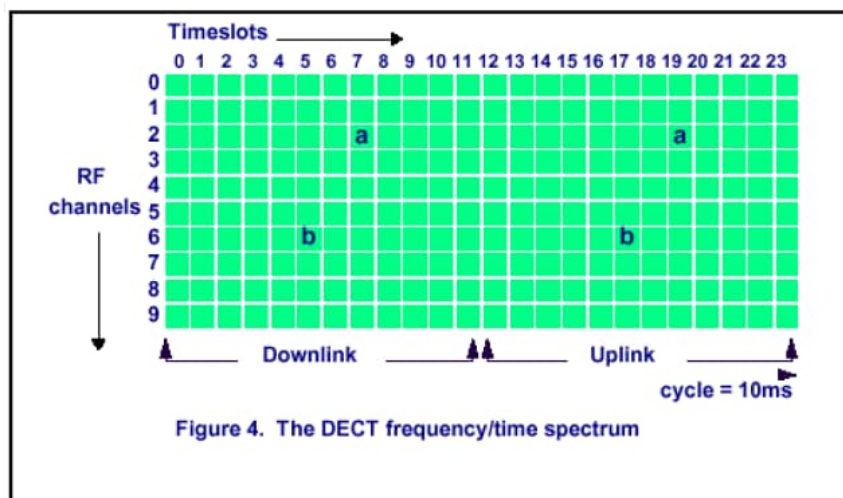
3.3.1 DECT Channel Access Procedure

DECT operates in North America in the frequency range of 1921.536 MHz – 1928.448 MHz. This range is divided into 5 channels. DECT uses a division of frequency carriers into 24 time slots (TDMA). There are 12 time slots for the downlink and 12 time slots for the uplink.

3.3.2 DECT Frequency Channels

The diagram below illustrates the division of the frequency band into the respective channels, as well as the division of a single channel into time slots. For a DECT connection, only one channel is occupied. This channel is used until interference on it causes the DECT system to switch to another channel. Each channel is divided, as already mentioned, into 24 time slots, forming one frame. The duration of one frame is 10 ms. It can also be seen that each DECT connection occupies a corresponding time slot in the downlink (receiving mode) and a time slot on the same channel in the uplink (transmitting mode).

For a Portable Part (PP), only one DECT connection is possible at most; therefore, only one channel is used, with one time slot for uplink and one time slot for downlink. For a Fixed Part (FP), up to four DECT connections are possible; therefore, up to four channels are used, and in each case four time slots for uplink and four time slots for downlink are occupied.



Please note that the diagram above only shows the Frequency table for Europe. In the US there are only 5 channels.

3.3.3 Calculation of the average output power

3.3.3.1 Calculation of the time slot timings

TDMA time: 10 ms.

Time slots per 1 TDMA time: 24.

Time per time slot: $10 \text{ ms} / 24 = 216.6 \text{ } \mu\text{s}$.

3.3.3.2 Calculation of the maximum TX time per bit

Time per time slot: $416.6 \text{ } \mu\text{s}$.

Maximum possible Bits/TimeSlot: 408 Bits.

Tx Time/Bit: $416.6 \text{ } \mu\text{s} / 408 \text{ Bits} = 868 \text{ ns}$ (per Bit).

3.3.3.3 Size of a MAC-Frame of the CT-DECT Module

A-Field = 64 Bit = control information + quality information.

S-Field = 32 Bit = synchronization of the receiver.

B-Field = 320 Bit = user data.

Z-Field = 4 Bit = cycle redundancy check.

Guard Bits = 10 Bits = Switching the transmitter output stage on/off.

MAC-frame size = 430 Bit

3.3.3.4 Calculation of the maximum TX time of the CT-DECT module

Tx Time = Tx Time/Bit x MAC-Frame size = $868 \text{ ns} \times 430 \text{ Bit} = 373.24 \text{ } \mu\text{s}$.

Tx time during a 10 ms TDMA time = $373.24 \text{ } \mu\text{s} / 10 \text{ ms} = 3.7324 \% = 0.037324$.

As declared by the applicant, a maximum of 4 connections can be established simultaneously.

Therefore, the maximum Tx time factor D is $0.037324 \times 4 = 0.149296$.

The formula to calculate the duty cycle correction factor may be found in 11.12.2.5.2.1 in [4].

The averaging factor is calculated as $10 \cdot \log_{10}(D) = 10 \cdot \log_{10}(0.149296) = -8.3 \text{ dB}$.

3.4 Bluetooth 2.4 GHz Emissions

The following information are based on Test-Report F251358E1 of PHOENIX TESTLAB GmbH. In the test report, the maximum emissions of Bluetooth classic+EDR and Bluetooth Low Energy were measured radiated, which means, that the Bluetooth module was located inside the EUT. As declared in the applicant's tune-up information declaration, the Bluetooth part has a tune-up range of 0.5 dB.

Antenna 0 General exemption CFR 47 §1.1307(b)(3)(i)(A)

Bluetooth classic+EDR / Bluetooth Antenna SAR Based Exemption CFR 47 §1.1307(b)(3)(i)(B)

P _{Conducted} [dBm] incl. Tuneup	P _{Conducted} [mW] incl. Tuneup	Ant. Gain [dBi]	Cable Attenuation [dB]	P _{e.i.r.p} [dBm]	P _{e.i.r.p} [mW]	P _{e.r.p} [dBm]	P _{e.r.p} [mW]
2.3	1.70	0	0	2.3	1.70	0.15	1.04
Frequency [GHz]	d [cm]	ERP _{20cm}	x	factor limp worn	P _{th} [mW]	P _{e.r.p.} [mW]	Result
2.402	1.6	3060	1.898	1.0	25.35	1.04	exempted
for $0.5 \text{ cm} \leq d \leq 20 \text{ cm}$ and $1.5 \text{ GHz} \leq f \leq 6 \text{ GHz}$							

Bluetooth Low Energy / Bluetooth Antenna SAR Based Exemption CFR 47 §1.1307(b)(3)(i)(B)

P _{Conducted} [dBm] incl. Tuneup	P _{Conducted} [mW] incl. Tuneup	Ant. Gain [dBi]	Cable Attenuation [dB]	P _{e.i.r.p} [dBm]	P _{e.i.r.p} [mW]	P _{e.r.p} [dBm]	P _{e.r.p} [mW]
1.9	1.55	0	0	1.9	1.55	-0.25	0.94
Frequency [GHz]	d [cm]	ERP _{20cm}	x	factor limp worn	P _{th} [mW]	P _{e.r.p.} [mW]	Result
2.402	1.6	3060	1.898	1.0	25.35	0.94	exempted
for $0.5 \text{ cm} \leq d \leq 20 \text{ cm}$ and $1.5 \text{ GHz} \leq f \leq 6 \text{ GHz}$							

3.5 DECT Emissions

The following information are based on Test-Report G0M-1702-6254-TFC15DFP-V03 by Eurofins Product Service GmbH. In that test report, the maximum conducted transmit power is 19.7 dBm. The antenna gain stated in that test report is 3.5 dBi. Including the averaging factor of -8.3 dB, as described in chapter 3.3 of this report. As declared by the applicant's tune-up declaration, the conducted output power including tune-up range of the DECT module is 20 dBm – 8.3 dB (duty cycle correction) the resulting conducted average output power is 11.7 dBm.

P _{con} [dBm] incl. Tuneup	P _{con} [mW] incl. Tuneup	Ant. Gain [dBi]	Cable Attenuation [dB]	P _{e.i.r.p} [dBm]	P _{e.i.r.p} [mW]	P _{e.r.p} [dBm]	P _{e.r.p} [mW]
11.7	14.79	3.5	0	15.2	33.11	13.05	20.19
Frequency [GHz]	d [cm]	ERP _{20cm}	x	factor limp worn	P _{th} [mW]	P _{e.r.p.} [mW]	Result
1.921536	1.5	3060	1.849	1.0	25.43	20.19	exempted
for $0.5 \text{ cm} \leq d \leq 20 \text{ cm}$ and $1.5 \text{ GHz} \leq f \leq 6 \text{ GHz}$							

Due to the fact that for separation distances larger than d the value for P_{e.r.p} is lower than P_{th} this emission is exempted from SAR Evaluation

3.6 Simultaneous transmission

As declared by the applicant, only Bluetooth LE and DECT or Bluetooth classic+EDR and DECT can transmit simultaneously.

Ratio assessment (DECT + Bluetooth classic+EDR):

	$P_{e.r.p}$ [mW]	P_{th} [mW]	$P_{e.r.p} / P_{th}$ Ratio
DECT	20.19	25.43	0.79394416
	$P_{e.r.p}$ [mW]	P_{th} [mW]	$P_{e.r.p} / P_{th}$ Ratio
Bluetooth classic+EDR	1.04	25.35	0.0410
		Limit	Sum Ratios
		1	0.8350

Ratio assessment (DECT + Bluetooth Low Energy):

	$P_{e.r.p}$ [mW]	P_{th} [mW]	$P_{e.r.p} / P_{th}$ Ratio
DECT	20.19	25.43	0.79394416
	$P_{e.r.p}$ [mW]	P_{th} [mW]	$P_{e.r.p} / P_{th}$ Ratio
Bluetooth Low Energy	0.94	25.35	0.0371
		Limit	Sum Ratios
		1	0.8310

4 Conclusion

The MULTI M7 M2 complies in all operational modes to the limits given in CFR 47 §1.1310(e)1 in a separation distance of 15 mm for the DECT antenna and 16 mm for the Bluetooth antenna. The separation distances to the user are realized by way of integration of the modules in the housing (see 3.2 for details).

5 Report History

Report Number	Date	Comment
F251358E3	05.03.2026	Initial Test Report
-	-	-
-	-	-